In vitro dissolution, bioactivity and cytotoxicity of wollastonite–diopside glass-ceramics from preceramic polymer and fillers

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Resumo:
Recently, wollastonite-diopside (W-D) glass-ceramics foams have been successfully prepared by a new processing route, consisting of the heat treatment of a silicone resin embedding micro-sized CaCO3 particles, that act as reactive fillers, and bioactive glass powder (G20CaII) based on SiO2–CaO–MgO–Na2O–Li2O system. As Ca–Mg silicates are receiving a growing interest in the field of bioceramics, this study investigates in vitro degradation, bioactivity and cell response of W–D glass-ceramics. Monolithic pellets were prepared using Mg(OH)2 and CaCO3 micro-particles, mixed with MK (silicone resin), Na2B4O7 and G20CaII glass in different amounts (A1(0%), A2(30%), A3(70%) and A4(100%) wt.% of the theoretical ceramic yield of the other components). MK was dissolved in isopropanol and then mixed with micro-sized fillers, including sodium borate. The mixtures were dried at 80 °C overnight. After drying, the silicone-based mixtures were in the form of solid fragments, later converted into fine powders by ball milling at 350 rpm for 30 min. The powders were cold-pressed in a cylindrical steel die applying a pressure of 20 MPa for 1 min, without using any additive. The samples were fired at 900 or 1100 °C for 1 h, using a heating rate of 1°/min. In vitro dissolution behavior of the materials in phosphate buffered saline (PBS) at 37 °C for a period up to 21 days was investigated. The structural and topographical properties of the glass-ceramics were studied using XRD, FTIR and SEM techniques, before and after storing in simulated body fluid for different time intervals. The cytotoxicity test was conducted with fibroblast cell line (Balb/c) by using MTS assay as cell viability end point. The results showed that the novel W–D glass-ceramics (A3-900°C, A4-900°C and A2-1100°C) exhibits the formation of an apatite-like layer on their surface after immersion in SBF for 7 days thus confirming their surface reactivity. XRD results showed that these samples crystallize mainly to diopside (CaMgSi2O6) and wollastonite (CaSiO3) but also combeite (Na2Ca2Si3O9) phase was detected. Additionally, the samples A3-900°C, A4-900°C and A2-1100°C suggesting different degradation behavior, initial weight loss, but after 14 days of immersion, a weight gain can be observed. For these materials, no changes in pH values during in vitro dissolution test were detected. Only these samples were considered non-cytotoxic.